Proceedings of the SYMPOSIUM ON INTENSIVE CULTURE OF NORTHERN FOREST TYPES

USDA FOREST SERVICE GENERAL TECHNICAL REPORT NE-29
1977

FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
6816 MARKET STREET, UPPER DARBY, PA. 19082

FOREWORD

THE NORTHERN FOREST TYPES constitute a vast natural resource for the United States and Canada. For instance, in the eastern United States there are more than 10 million acres of commercial forest land supporting spruce and fir types alone. The magnitude and variety of this resource is such that treating it in any detail at a 3-day meeting was impossible. Rather, the idea that germinated and developed into this symposium was to present a broad picture of the extent of our knowledge of intensive cultural techniques, the status and trends of our research in the northern forest types, and some actual experiences in managing this resource; and to explore those factors that affect our use of the intensive cultural techniques we have at hand.

There is no doubt that we face a new era in the management of northern forests. The production of wood products is no longer the primary objective of many owners, and increased pressure for the social values of our forests is being felt by all landowners. We must recognize these other forest values, which in turn dictates intensification of all aspects of forest management if we are to meet the future demands of a wood-hungry society.

The enthusiastic efforts of the symposium sponsors—the School of Forest Resources, University of Maine; the Maine Bureau of Forestry; the Maine Forest Products Council; and the U.S.D.A. Forest Service—and the individuals behind those efforts, should be commended. Special thanks are due to Great Northern Nekoosa, Inc., and Brooks B. Mills for their help in providing interesting field trips, and to the Casco Bank and Trust Co. for sponsoring the symposium brochure. Also, without the enthusiastic participation of the experts invited to present papers, and the moderators of each session, the Symposium could not have taken place.

—BARTON M. BLUM
Symposium Chairman

PUBLISHER'S NOTE

This report is published by the Northeastern Forest Experiment Station as a public service. The papers it contains are published as received from the authors. Any questions or comments about these papers should be directed to the authors.

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held 20-22 July 1976 at Nutting Hall, University of Maine, at Orono.

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Fred Holt, Maine Bureau of Forestry (retired): 20 July 1976, afternoon session.

Ray McDonald, Casco Bank & Trust Company: 21 July 1976, morning session.

Dick Kennell, USDA Forest Service, State & Private Forestry: 21 July 1976, afternoon session.

C. D. Hartley, Valley Forest Products Ltd., Canada: 22 July 1976, morning session.

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THE STATUS OF TREE IMPROVEMENT PROGRAMS FOR NORTHERN TREE SPECIES

by David S. Canavera, Assistant Professor of Forest Resources, University of Maine, Orono, Maine.

Abstract

Forest tree improvement research and application in the Northeast is reviewed in the perspective of past development and future needs. Control over provenance selection can provide the best quality seed for today's reforestation programs. Future supplies of seed must come from seed orchards if forest land owners are to attain the maximum production per unit area as industrial reforestation efforts in the region increase.

When one considers the intensive culture of forests with any type of planting program, it is logical to include a tree improvement program to assure that you are planting seedlings of superior genetic quality. The very active and intensive tree improvement programs in the southeastern and western United States have focused worldwide attention on the tremendous gains that are possible through forest tree breeding (Zobel 1974). Foresters from the northern states visiting these areas are invariably impressed with the modern seed extraction facilities, expansive nurseries and greenhouse complexes, vast acreages of seed orchards, and the thousands of acres of fast growing plantations. In this paper, I would like to place in perspective for northern species the tree improvement activities to date and what I envision the prospects to be for the future. Most of my comments will be directed to the Northeastern states in general and Maine in particular.

As evidenced in the southeastern and western states, the development of tree improvement programs requires economic justification for their implementation. Forest industries and forest managers have responded to and accepted change only when they have found it economically advantageous. Several innovations in harvesting techniques in the Northeast such as tree-length logging and complete tree chipping have

extended the fiber supply. These methods, however, became acceptable only when the lack of labor made it physically impossible to harvest a sufficient quantity of wood or the economics of wood production dictated a change. The same might be said of tree improvement in the Northeast: the acceptance of planting genetically improved seedlings by industrial and other foresters will result only when it becomes economically attractive or necessary, or because a potential shortage of raw materials requires a new approach to forest management.

PAST HISTORY OF TREE IMPROVEMENT IN THE NORTHEAST

The development of tree improvement in the Northeast is well documented in the "Proceedings of the Northeastern Tree Improvement Conferences", which have been held annually since 1953 (Garrett 1972). Notable among these accomplishments is that the first large-scale breeding project in the world devoted exclusively to the genetic improvement of forest trees was begun in 1924 by the Oxford Paper Company of Rumford, Maine in cooperation with the New York Botanical Garden (Schreiner 1975). The objective of this project was to produce rapid-growing poplar (Populus) hybrids for pulpwood reforestation. Today these hybrids have been planted extensively around the world. They have not, however, been planted to any large extent by the local industries for which they were developed.

Special mention should also be given to the early efforts made to breed American Chestnut (Castanea dentata (Marsh.) Borkh.) resistant to the chestnut blight fungus (Endothia parasitica) (Jaynes 1969). This effort was begun in 1929 by Dr. A. H. Graves of the Brooklyn Botanic Garden and has been continued to date by the Connecticut Agricultural Experiment Station.

With the exception of the two previously mentioned examples, most of the early tree improvement work in the Northeast was concerned with species introduction and provenance testing. Emphasis was placed on european and asiatic conifers adapted to plantation culture. These early tests quickly pointed out the significant contribution genetics makes to growth rate, seedling survival, form, wood properties, etc.

CURRENT RESEARCH PROGRAMS

Programs in tree improvement research are currently being carried out in all of the Northeastern and Lake States as well as the Canadian provinces. The work is being conducted by universities, federal governments, state agencies and private industries. The areas of investigation for purposes of discussion can be categorized as follows: (1) exotic species introduction and provenance testing; (2) individual tree selection and progeny testing; (3) hybridization; and (4) vegetative propagation.

Exotic species introduction and provenance testing. The northeastern region of the United States including the Lake States and southeastern Canada are very fortunate to have climates similar to several northern hemispheric regions of the world that contain valuable forest tree species. This condition permits us to successfully plant several of these species and in many instances obtain growth rates superior to our indigenous species. Today proper species selection and specific provenance recommendations can be made with a high degree of assurance for success. Besides the early provenance tests, several recent large-scale intensive provenance tests of indigenous species have been assembled and are currently being field tested in both the United States and Canada. For the most part, these recent tests are being conducted on species that show a large amount of genetic variation (e.g. jack pine (Pinus banksiana Lamb.)) or species that have gained in importance in recent years (e.g. black spruce (Picea mariana (Mill.) B.S.P.) and white birch (Betula papyrifera Marsh.)).

Both the earlier and more recent tests have shown dramatic differences for such traits as: (1) growth rate in white spruce (Picea glauca (Moench) Voss), eastern white pine (Pinus strobus L.), Norway spruce (Picea abies (L.) Karst) and Scotch pine (Pinus sylvestris L.); (2) form and foliage color in Scotch pine; (3) disease resistance in jack pine; and, (4) frost resistance in Douglas fir (Pseudotsuga menziesii (Mirb.) Franco) (Nienstaedt and Teich 1972, Wright 1970, Baldwin et al. 1973, Wright and Bull 1963, King and Nienstaedt 1965, Hattmer and Konig 1975). The general area where most information is still lacking is with hardwood species, however, this void is rapidly being filled as hardwoods are destined to become more important in this region.

Individual tree selection and progeny testing. The tree improvement programs in the southern and western states have for the most part been based on individual tree selection and progeny testing. The primary reason for this is that at the inception of the tree improvement programs in those regions in the 1950's, there already existed extensive planting programs and the immediate need was to obtain the maximum amount of genetic gain in the shortest possible time span. The approach taken was to establish clonal seed orchards from highly selected trees. This need, to obtain immediate genetic gain, did not exist to the same degree for most northern species as planting programs were comparatively small. Thus, individual tree selection was not given much emphasis. During the last fifteen years, however, this field of research has expanded rapidly and selection programs have been made or are currently in progress for many of the commercially important species. Population parameters and heritability estimates are rapidly being gathered for the commercially important traits such as growth rate, specific gravity, etc. (Morgenstern et al. 1975).

Hybridization. Inter-specific hybridization in the pines, spruces, poplars, and larches have produced several combinations that hold considerable promise for increased growth (Fowler and Yeatman 1973). Perhaps the hybrid in the Northeast that has received the most attention besides hybrid poplar is the Larix decidua x leptolepis combination. Trees from this cross have made astounding growth on well-drained sites throughout the region. Both seed and seedlings are available periodically from the state of New York.

Vegetative propagation. Methods of vegetative propagation by grafts and cuttings have been developed for the important northern species. Much research, however, should still be conducted on the grafting and rooting of spruce species. Especially critical is the propagation of trees that have been attacked by the spruce budworm (Choristoneura fumiferana (Clemens)). In recent years much progress has also been attained in the methods of cell and tissue culture as a means of vegetative propagation (Brown 1976).

ANALYSIS OF THE APPLICATION OF RESULTS

The ultimate objective of all tree improvement programs is to control seed quality. Ideally all seeds sown in nurseries or greenhouses should reflect some

degree of genetic control. This objective has been attained by several organizations, however, it is still lacking in others. The practice of buying cones and seed on the open market still exists. The greatest degree of control has been attained in the Lake States, Canadian provinces and the state of New York. In these areas: (1) seed zones have been established to regulate the flow of seed across ecological zones; (2) seed production areas have been established for many species to ensure a continuing supply of seed from designated areas and environments; (3) seed orchards have been established. The 1974 Directory of Forest Tree Seed Orchards in the U. S. lists 434 acres of seed orchards for all species for the geographic region from Connecticut to Minnesota. This number is quite small when compared to the fact that Florida alone has 1606 acres of seed orchards.

FUTURE PROSPECTS

The amount of acreage planted each year in the northern region has steadily decreased since it reached its maximum in the early 1960's. These plantings for the most part were federally subsidized by the Federal Soil Bank Program and established on abandoned farm fields.

I believe the Northeast will see a dramatic expansion of applied tree improvement and planting programs in the near future. This development, especially in the state of Maine, will be spearheaded by forest industries. The need will be brought about by the growing demand for fiber and the realization by industry and state governments that cutover forest lands must be fully stocked with suitable species at a desirable spacing as soon after cutting as possible so that optimum growth can be attained. The need now for the region is one of "applied technology". A sufficient background of information from researchers in the United States, Canada and the Scandinavian countries on containerized growing, accelerated growth, site preparation and genetic principles exists to mount a truly active tree improvement program.

In Maine alone there are approximately 17.2 million acres of commercial forest land. Traditionally the State has been in the very favorable position of having an annual cut well below the growth. However, long-range forecasts by the U. S. Forest Service predict that by the year 2000 we shall have twice the

demand for pulpwood than we now produce (Ferguson and Kingsley 1972). As implied earlier, improved utilization can augment and extend timber supplies, but the major long-term reliance must rest entirely on increased productivity of all available commercial forest land. This increased productivity can be attained by sound investment in the land and those trees growing on the land.

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